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Original Article

Aneurysmal Subarachnoid Hemorrhage: Geography has a Role

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Abstract

Background: The incidence of aneurysmal subarachnoid hemorrhage (SAH) reported in the literature has been very variable. Many authors have proposed a geographical variation in incidence, but others have dismissed this as being due to insufficient pickup rate. In India also, these arguments abound. Our aim was to find out if geographical variations exist in the incidence of aneurysmal SAH and whether the incidence of aneurysmal SAH was truly less in India as compared to the literature. **Materials and Methods:** The data from 182 consecutive cases of SAH admitted to this institution between March 1999 and July 2003 were used for this study. **Results:** There were 84 females and 98 males in this study. More than half of the patients were hypertensive. Four-vessel angiogram was done in 113 patients, of whom sixty-nine were normal. Of the patients with hypertension, 92% had angiogram done and was normal in 65% of cases. **Conclusions:** This study from a large general hospital in South India shows that the incidence of aneurysmal rupture as a cause of SAH is much less in India and probably in the Indian subcontinent in comparison with the western literature thus demonstrating geographical variations in the incidence of aneurysmal SAH. It is concluded that aneurysms as a cause of SAH are still less in India and that we are not missing anything. This study is intended to help target scarce, expensive resources toward more common pathologies.

Keywords: *Aneurysms, incidence, rupture, subarachnoid hemorrhage*

Introduction

Does the incidence of aneurysmal subarachnoid hemorrhage (SAH) have a geographical variation? Is the incidence of aneurysmal SAH less common in India? These are questions that are being asked again and again but still remain controversial. SAH is of varied etiology, but western literature has shown that an aneurysm rupture is the most common cause.[1] There have been a few studies from India which have shown this to be the case whereas others have disputed this view.[2-7] The aim of this article is to look into this question to try and get an answer if possible. Other western studies have also shown a very high incidence of aneurysmal rupture as a cause of SAH.[8,9]

Materials and Methods

The case records of all consecutive cases of spontaneous SAH proved clinically, radiologically, and/or lumbar puncture studies and admitted to Medical College Hospital, Kozhikode, Kerala state, India, between March 1998 and July 2003 were used for this retrospective analysis. Patients with the perimesencephalic type of SAH were excluded from the study. After this, a total of 182 case records were obtained. The clinical, radiological, and treatment details as well as outcome were looked up. The patients had been assessed clinically and graded. Based on the clinical condition of the patient, angiograms were done and appropriate management given.

Results

There were 84 females and 98 males in this study. The youngest patient was 20-year-old and the oldest was 73. Mean age was 45 and median age was 48. The clinical presentations [Table 1] included headache and vomiting in 70% (95% confidence interval [CI] 0.63–0.76), seizures in 20% (95% CI 0.14–0.26), deterioration in sensorium in 56% (95% CI 0.48–0.63), and focal neurological deficits in 24% (95% CI 0.074–0.17). More than half of the patients were hypertensive (95% CI 0.49–0.63) and about 35% were diabetic. A majority of the patients presented in a good Glasgow Coma Scale and 70% of the patients had a good Hess and Hunt grade [Table 1].

CT scan was done in all cases and was normal in eight percent of cases in

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which cerebrospinal fluid study confirmed the diagnosis. Four-vessel angiogram was done in 113 patients [Table 2]. It was seen that of these, 69 (61%) were normal. Digital subtraction angiography was repeated in 46 of these cases and all were normal. Of the aneurysms detected, anterior communicating artery aneurysm was the most common. Of the forty aneurysms, 26 were surgically clipped and rest were coiled by endovascular techniques. There was a mortality of 26% and more than half of our patients were independent at 3 months [Table 3, 95% CI 0.452–0.60]. Of the 102 patients with hypertension, 72 had angiogram done which was normal in 65% of cases (95% CI 0.53–0.75).

A comparison was attempted between the incidence of aneurysms in the cooperative study and two other studies mentioned previously with the incidence in this study. The incidence of aneurysms in this study was less and this finding was statistically significant ($P = 0.008$).

Discussion

This is a retrospective analysis of 182 cases of confirmed spontaneous SAH. Angiograms were done in 113 cases, of which 61% were normal. Moreover, angiogram was normal in 65% of the hypertensive patients. These two factors favor the point that aneurysmal SAH may be much less in India compared to the western literature and this observation is statistically significant.

One study from Vellore in India over a 15-year period had an incidence <0.5% cases of SAH.[5] Of these in 30 cases, no cause of bleed could be seen, 10 were due to angiomatous malformations, and only five were aneurysms. Ramamurthi[6] opined that even though awareness could be an issue, it still seemed that the incidence of SAH and intracranial aneurysms was very low. The Indian Council of Medical Research[7] study showed an incidence of 34% of aneurysms and 31% were hypertensive. This study done in six centers in India found that once the diagnosis was confirmed and the patient investigated well, aneurysm continued to be the most common cause of subarachnoid bleed. The centers were in different parts, but the authors found that cities in North India showed a higher incidence compared to that in South India. The authors concluded that incidence of saccular aneurysms seems to be same as other reports.

Sambasivan *et al.*[2] presented their analysis on 1000 cases of SAH. In this large series, angiograms were done in 680 cases and they had an incidence of 49% of aneurysms. They also found that Group I and II patients tolerated surgery well. Devadiga[3] in his series had angiograms done in nine cases that showed aneurysms in three (33%). Banerjee and Prakash[4] had a reported incidence of 47% of aneurysms in their series. Only 30% of patients were in good grades. They felt that late referral and lack of suspicion could be a cause for this. All these studies argued

Table 1: Clinical profile

Time duration	March 1999-July 2003		
Number of cases (*n*)	182		
Age			
20-29	1		
30-39	5		
40-49	65		
50-59	57		
60-69	43		
>70	11		
Male:female	98:84		
Clinical features (%)			
Headache/vomiting	127 (70)		
Seizures	36 (20)		
Loss of consciousness	101 (56)		
Focal deficits	22 (24)		
Associate illness			
Hypertension	102 (56)		
Diabetes	61 (33)		
GCS at admission, *n* (%) (95% CI)			
3-6	22 (12) (0.074-0.17)		
7-12	58 (32) (0.25-0.39)		
13-15	102 (56) (0.49-0.63)		
Grading Hess and Hunt	***n* (%)**	**WFNS**	***n* (%)**
1	112 (62)	1	114 (63)
2	26 (14)	2	31 (17)
3	24 (12)	3	18 (10)
4	10 (5)	4	11 (6)
5	10 (5)	5	8 (4)

WFNS – World Federation of Neurological Surgeons; GCS – Glasgow Coma Scale; CI – Confidence interval

Table 2: Radiological profile

CT head	182
SAH in CT (%)	167 (92)
Normal (%)	15 (8)
Angiogram	113
Normal angiogram	69
Single aneurysm	37
Double aneurysm	3
AVM	4
ACom artery	23
MCA	8
Distal ICA	5
DACA	1
PCom artery	3
Treatment	
Clipping	26
Endovascular	14
2 AVM embolized, one excised	

SAH – Subarachnoid hemorrhage; CT – Computed tomography; ICA – Internal carotid artery; DACA – Distal anterior cerebral artery; MCA – Middle cerebral artery; AVM – Arteriovenous malformation; ACom – Anterior communicating; PCom – Posterior communicating

Table 3: Outcome at 3 months (Glasgow Outcome Scale)	
Independent (no deficits)	96 (53)
Mild to moderate disability	17 (10)
Dependent (focal deficits)	7 (3)
Bedridden	14 (8)
Death	48 (26)

Table 4: Hypertension versus subarachnoid hemorrhage	
Hypertensive	102 (100)
Angiogram	72 (92)
Normal	46 (65)
Aneurysm	22 (30)
AVM	4 (5)

AVM – Arteriovenous malformation

that the incidence of SAH was comparable to the incidence of aneurysmal SAH as reported in the western literature at that time.

Many western studies have shown a high incidence of aneurysms as the cause for SAH. In the cooperative study, the incidence of aneurysms was 51%.[1] In this cooperative study, based on 6368 patients, 54% had at least one aneurysm and 6% had an arteriovenous malformation. In this study, 22% of the patients with an anterior circle aneurysm bleed again in the first 2 weeks and 15% in the next two, but 11% of all rebleeding episodes occurred after a delay of over 1 year.[1] Burrows and Leeds reported that aneurysms were responsible for spontaneous SAH in 58.6% of cases whereas Sengupta and McAllister had a much higher figure of 73.4%.[8,9]

There have been many studies describing an influence of the geographical region and the ethnic groups studied. One study[10] showed that the incidence of SAH for white Danes was 3.1/100,000 whereas for Greenlandic Eskimos, it was 9.3/100,000. Weighting differences between the two populations regarding population size, age distribution, and number of patients, the relative risk for Eskimos compared with Caucasian Danes was 4.4. In an attempt to account for this finding, the possibility of different connective tissue properties in the two populations was postulated.[10] Another reported[11] that the incidence of SAH for Europeans in New Zealand was 14.3/100,000 and for Maoris, it is 25.7. Similarly, in a study on the incidence of stroke, it was reported that the incidence of SAH among African Americans was 2.1 times that of Caucasians.[12] In another study, from Greenland, it was seen that Inuit patients had a much higher rate of family history of SAH compared to Danish patients.[13] An article from China showed that the incidence of ruptured intracranial aneurysms in the Chinese was low.[14]

There have been a few studies from the Middle East. A study from Morocco confirmed that cerebral aneurysms are not rare in Morocco.[15] The authors concluded that a critical reading of the published articles claiming a low incidence of cerebral aneurysms in Africa, the Middle East, and Asia shows that this conclusion is not based on accurate and reliable statistical studies. Another study from Saudi Arabia concluded that SAH was less common than the global average but was not as rare as was previously thought.[16] A third study by al-Mefty *et al*.[17] from the Middle East concluded that although environmental or inherited factors may predispose to a lower incidence of intracranial aneurysm in the Middle East, the true incidence is higher and is not apparent because of the previous referral system for medical care. The authors felt that medical facilities and expertise are rapidly improving, and future studies undoubtedly will show a higher incidence of intracranial aneurysm. Nogueira reported his findings from the State of Qatar in the Middle East and concluded that the low incidence of spontaneous SAH and aneurysmal rupture in the Middle East was a fact.[18] Two studies from Japan had showed the high incidence of SAH in Japan.[19,20] The first study confirmed the high incidence of SAH in Japan. The other study suggested that the actual incidence rates of both primary intracerebral hemorrhage and aneurysmal SAH in Japan seem to be much higher than have been reported so far. All these studies point to the wide geographic and racial variations in the incidence of SAH.

There have been a few recent studies from India. One was a study of the circle of Willis with its anatomical variations and incidence of atherosclerosis carried out in 1021 consecutive autopsies.[21] The prevalence of aneurysms (0.2%) was definitely much lower than that seen in other series, thus, suggesting that the incidence of SAH from aneurysmal rupture is likely to be genuinely less in India. Another study examined one thousand human brains of both sexes and aneurysms were found in ten specimens (1%).[22] A third article showed that for the preceding 2–3 years of the study, after an increasing awareness of its entity among the physicians and the population, only 300–350 aneurysms were seen in the cities of Mumbai and Delhi with a population of 13 and 8 million, respectively.[23] This, the author explained was proof enough that the incidence of aneurysmal SAH was much lower in India compared to western countries. Finally, a study from the US looked at 1711 adult patients with aneurysmal SAH and suggested that the higher SAH mortality rate previously observed in African-American patients is likely to be as a result of a higher incidence of SAH in this group.[24] However, they concluded that race was not a prognostic factor for outcome after aneurysmal SAH.

There have been two recent studies in this direction. One study by Fukuhara[25] was done in Japan. The use of the diagnosis procedure combination database for epidemiological studies was analyzed. The results were

suggestive of large regional variations in aneurysmal SAH incidence. Another work by Lai *et al*.[26] showed variations of SAH with climate. They used a nationwide sample to analyze the association between specific meteorological parameters – temperature, precipitation, sunlight, and humidity – and hospital admission rate for and outcome after aneurysmal SAH. It was found that daily decreased sunlight and lower relative humidity were associated with an increased rate of admission for ruptured cerebral aneurysms but had no association with differential inpatient mortality. de Rooij *et al*.[27] analyzed 51 studies in 21 countries. They concluded that the overall incidence of SAH is approximately 9/100,000 person-years. Rates are higher in Japan and Finland and increase with age. The preponderance of women starts only in the sixth decade. The decline in incidence of SAH over the past 45 years is relatively moderate compared with that for stroke in general. Labovitz *et al*.[28] studied the incidence of SAH among the whites, Hispanics, and blacks of Manhattan region. They found that compared with whites, the rate ratio of SAH was 1.3 for Hispanics and 1.6 for blacks.

An interesting information obtained from the study was that of the 102 patients with hypertension, angiograms was done in 92% of the patients. Of these 35% showed either aneurysm or AVM. This is slightly more than the average. So patients with long standing hypertension have a higher risk of having aneurysm or AVM [Table 4]. Medical College, Kozhikode, covers a population of around 5 million in north Kerala, a state in South India. This hospital is a typical representation of the population with a homogenous ethnic group.

Even though this is a retrospective study with its disadvantages, it seems that the incidence of aneurysmal SAH is genuinely much less in India and aneurysmal SAH does have a geographical variation in incidence. Many other parameters such as profession, relation to recent exercise, use of certain drugs, general health, and anticoagulants could not be obtained in detail because of this. Furthermore, the often repeated statement that the true incidence of aneurysms is less in some countries because reduced pick up rate does not hold true in this series as only spontaneous SAH patients have been included in the study.

Conclusions

Aneurysms as a cause of subarachnoid haemorrhage may not be uniformly distributed and does have a geographical variation.

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Conflicts of interest

There are no conflicts of interest.

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